

Examiners' report

GCSE

COMBINED SCIENCE A (GATEWAY SCIENCE)

**OCR Level 1/Level 2 GCSE (9-1) in
Combined Science A (Gateway Science)**

J250

For first teaching in 2016

J250/06 Summer 2025 series

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Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. A selection of candidate responses is also provided. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.

A full copy of the question paper and the mark scheme can be downloaded from [Teach Cambridge](#).

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Paper 6 series overview

J250/06 is the second physics Foundation Tier paper in the GCSE Combined Science (Gateway Science) suite. It assesses content from specification topics P4-P6. It also assumes knowledge of the topics in P1-P3. To perform well on this paper, candidates need to have a sound knowledge of the theory covered in topics P4-P6 and to be able to apply this to novel situations. They also need to apply the skills and understanding that they have developed using the apparatus and techniques covered in topic CS7. This paper also contains questions that have elements of synopticity, drawing on material covered by topics P1-P3. There are also questions that involve the examination of key mathematical requirements from Appendix 5f of the specification. The last question was an overlap question with the Higher Tier paper

Candidates attempted most questions. Answers showed candidates having good attempts mathematical questions and those where information needed to be extracted.

It is important that candidates read the questions carefully, understand the command words and to make sure they are not just giving information from the question stem as their answers.

Candidates found questions requiring comparisons and relationships challenging as well as AO3 type questions that involved applying knowledge that was not provided to draw conclusions

Most candidates attempted the Level of Response question. They were able to identify controlled variables and suitable precautions needed to get accurate and reliable results.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
- were able to rearrange and substitute into given equations (Questions 11 (b) and 16 (b) (i)) - were able to balance a nuclear equation (Question 13 (c)) - showed clear working out (Questions 14 (a) (ii), 16 (b) (i) and (ii)) - understood that efficiency is related to energy dissipation (Questions 13 (d), 16 (b) (iii) and (iv)) - read questions carefully and tailored their answers accordingly (Question 15).	- could not convert between different unit prefixes (Questions 9 and 16 (b) (i)) - could not recall basic information (Questions 1, 11 (c) and 13 (e)) - could not state a standard definition (Question 13 (d)) - were challenged by questions that depended on recall of prior knowledge in order to process information (Questions 2 and 14).

Section A overview

This section consisted of 10 multiple choice questions. Virtually all candidates attempted all of these questions. Questions 1, and 3 assessed AO1, requiring recall, were correctly answered by the majority of candidates. Question 6 at standard demand was more discriminating. Questions 4, 5, 8 and 10 which required application of knowledge (AO2), were very well answered. Candidates found Questions 2, 7 and 9 more challenging. Candidates often showed their working out on the mathematical Questions 4 and 10.

Exam Technique when answering multiple choice

If a candidate needs to correct an answer, the answer in the box should be crossed out and the correct answer written beside the box. Candidates should not attempt to overwrite previous answers as this can make the answer difficult to distinguish.

Question 1

1 Which row identifies features of a **light wave**?

	Transverse	Longitudinal	Travels through space
A	x	✓	x
B	x	✓	✓
C	✓	x	✓
D	✓	x	x

Key

✓ wave has this feature
x wave does **not** have this feature

Your answer

[1]

Many of the candidates realised that light needed to travel through space but couldn't identify the type of wave. Option B was the common wrong answer.

Question 2

2 What is a typical speed for a **strong wind**?

- A 2 m/s
- B 13 m/s
- C 56 m/s
- D 330 m/s

Your answer

[1]

Only a minority of candidates scored this mark, option C was the most common answer. Candidates may have used their knowledge of wind speeds in miles per hour but did not process this into metres per second.

Question 3

3 Which electromagnetic wave is used for **cooking**?

- A Gamma rays
- B Infra-red radiation
- C Ultraviolet radiation
- D X-rays

Your answer

[1]

This was generally well answered. Option C was the most frequent wrong answer.

Question 4

4 A radio wave has a wavelength of 5.0 m.

A second radio wave has a wavelength which is a thousand times greater.

What is the wavelength of the **second** radio wave?

A 0.005 m

B 5.0 m

C 125 m

D 5000 m

Your answer

[1]

Most candidates answered this question correctly.

Question 5

5 Which energy source is **non-renewable**?

A Biofuel

B Nuclear fuel

C Solar

D Wind

Your answer

[1]

Majority of candidates got the correct answer. Option A was the most frequent incorrect answer.

Question 6

6 Which statement about electrons in atoms is **correct**?

- A Electrons gain energy as they absorb electromagnetic waves.
- B Electrons have a positive charge.
- C Electrons lose energy by emitting alpha particles.
- D Electrons rise to higher energy levels as they emit electromagnetic waves.

Your answer

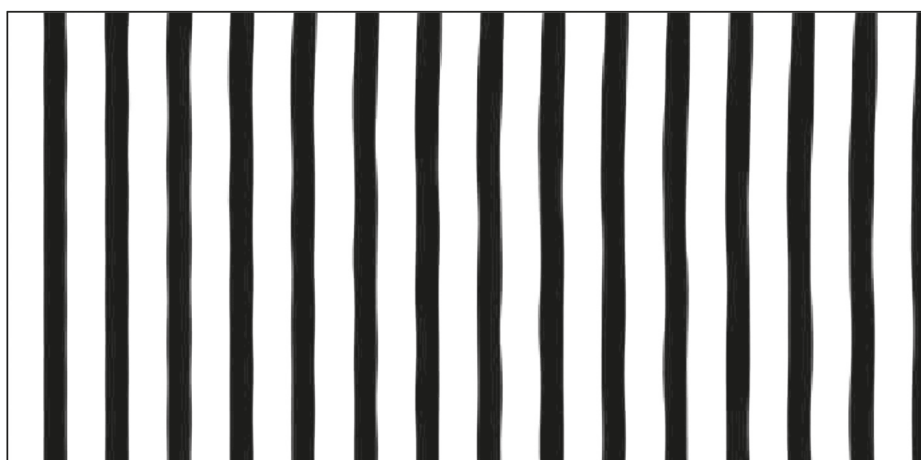
[1]

Candidates found this question more challenging. All possible options were given with a similar frequency.

Question 7

7 The diagram shows a photograph of the pattern of water waves, drawn to scale.

A student measures the wavelength of the water waves with a ruler.



Which method will **not** improve the accuracy of the student's measurement?

- A Place the ruler at a right angle to the wavefront.
- B Measure the length of 5 complete waves and divide this length by 5.
- C Place the ruler flat on the photograph and read the scale at right angles from above.
- D Use a longer ruler to measure one wavelength.

Your answer

[1]

Many candidates gained credit on this question. Option A was a frequently seen incorrect response.

Question 8

- 8 A group of scientists discover a new particle.

What must the scientists do so that their discovery is accepted?

- A Give the new particle a name.
- B Have their work reviewed by other scientists.
- C Make a television documentary about the discovery.
- D Post the discovery on the internet.

Your answer

[1]

Most candidates answered this question correctly.

Question 9

- 9 A student calculates that the energy used to make steel for a car is 1 260 000 000 J.

Which of these is equal to 1 260 000 000 J?

- A 1260 GJ
- B 1260 kJ
- C 1260 MJ
- D 1260 nJ

Your answer

[1]

Few candidates correctly answered this question. This question, along with Question 16 (b) (i), showed that unit prefixes and how to convert between them was challenging for candidates.

Question 10

10 Object **X** and object **Y** move at the same speed.

Object **X** has 10 J of kinetic energy.

Object **Y** has twice the mass of object **X**.

What is the kinetic energy of object **Y**?

A 5 J

B 10 J

C 20 J

D 100 J

Your answer

[1]

This was well answered by most candidates. Working was often shown beside the question.

Section B overview

The questions in this section consist of multi-option questions (1-3 marks), structured questions requiring longer written answers (1-2 marks) and calculations (2-3 marks). There was one 6-mark Level of Response question.

This section covers all Assessment Objectives. Question 16 is an 'overlap' question with J250/12, the corresponding Higher tier paper.

Almost all candidates attempted all questions. Questions 14 (a) (iii) was the least attempted.

Question 14 (b) (all parts) is an AO3 question which required application of knowledge of heat transfer. Candidates seemed to find this particularly challenging.

There was no evidence that candidates ran out of time.

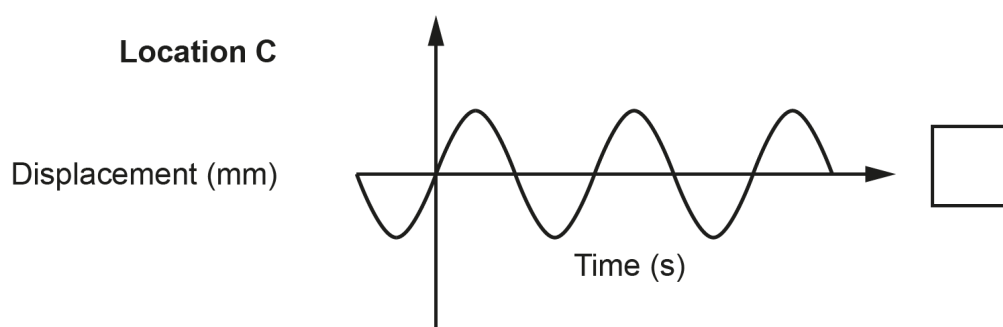
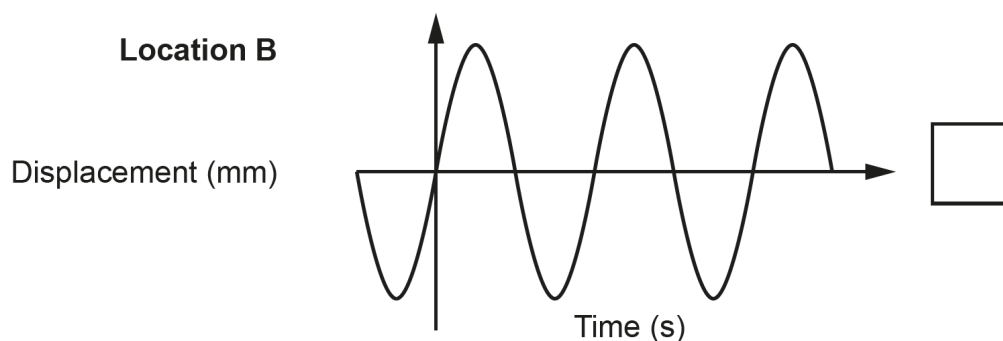
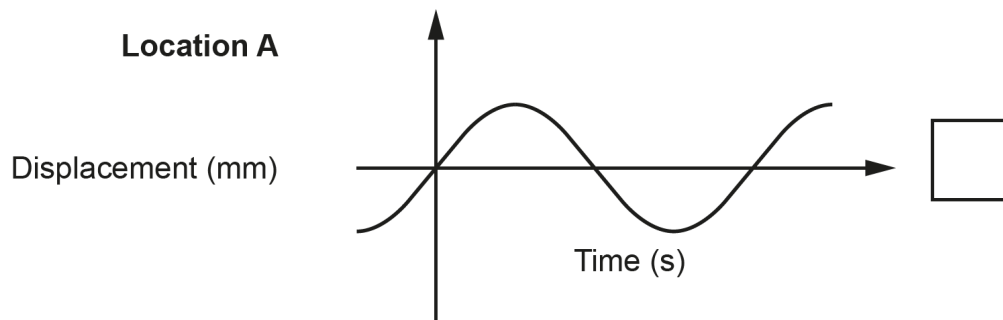
Question 11 (a)

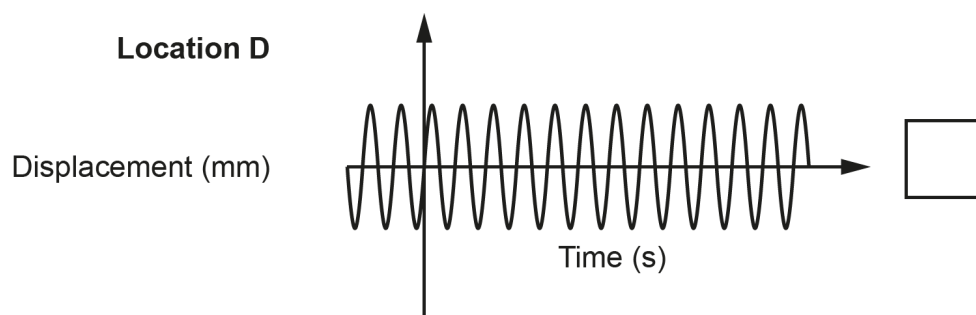
- 11** A sound engineer records sound waves from loudspeakers in four different locations **A**, **B**, **C** and **D** in a concert hall.

- (a)** An oscilloscope is used to display the sound waves produced at each location. The settings on the oscilloscope remain the same for each location.

At which location does the sound wave have the **greatest amplitude**?

Tick (✓) **one** box.





[1]

This was well answered by most candidates with option D as the most common error.

Question 11 (b)

(b) One of the sound waves recorded has a frequency of 250 Hz.

The speed of sound in the concert hall is 340 m/s.

Calculate the wavelength of this sound.

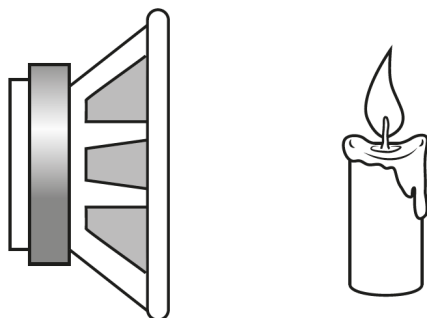
Use the equation: wave speed = frequency $\times$ wavelength

Wavelength = m [3]

Most of the successful candidates were able to substitute and rearrange the equation. The most common mistake was to just multiply the numbers given; $250 \times 340 = 85\,000$.

Question 11 (c)

(c) The engineer places a candle in front of a loudspeaker.



The loudspeaker produces a low frequency sound.

Complete the sentences to explain why the candle flame vibrates from side to side but does **not** blow out.

Use words from the list.

electromagnetic

longitudinal

particles

transverse

waves

The flame vibrates from side to side because sound waves are waves.

Air vibrate but do **not** travel through the flame.

[2]

Many candidates could not recall the difference between transverse and longitudinal waves. A few candidates also incorrectly answered this as electromagnetic.

'Particles' was answered correctly by most candidates.

Question 12 (a) (i)**12****(a)** All objects emit electromagnetic waves.

Thermal imaging cameras detect some electromagnetic waves.

The photograph is a thermal image of an animal taken using a thermal imaging camera at night.

**(i)** Which type of electromagnetic wave is the animal emitting?Tick (✓) **one** box.

Infra-red radiation

☐

Visible light

☐

X-rays

☐**[1]**

This question was well answered by most candidates.

Question 12 (a) (ii)

(ii) Why is a human **not** able to see the animal at night?

.....
..... [1]

The candidates who scored this mark generally answered with the idea of 'eyes can't see infrared'. Otherwise, most comments were 'it's too dark to see', 'humans can't see in the dark' or 'not enough light'. These answers were too vague for this standard demand question.

Exemplar 1

..we are unable to see the electromagnetic spectrum.....
..only visible light..... [1]

This is an example of a good answer where the candidate has demonstrated understanding that our eyes can only detect part of the electromagnetic spectrum.

Question 12 (b) (i)

(b)

(i) State **one** reason why ultraviolet, X-ray and gamma radiation can be harmful to living things.

.....
..... [1]

Most of the successful candidates scored this mark, usually for the idea of they all can cause cancer, but some also scored the mark for mutations or damage to cell. 'Ionising' was seen very rarely.

The answer 'causes radiation sickness' was not accepted as it is very unlikely from exposure to ultraviolet radiation.

Question 12 (b) (ii)

(ii) Ultraviolet, X-ray and gamma radiation are also useful.

Draw **one** line from each type of **electromagnetic wave** to a **typical use**.

Electromagnetic wave

Typical use

ultraviolet

sterilising surgical equipment

X-ray

detecting fake bank notes

gamma ray

making images of bones

[2]

This was generally well answered. Most candidates were able to score at least 1 mark, linking 'X-rays' to 'making images of bones'.

Question 13 (a)

13 There are different isotopes of the element carbon.

(a) The isotope carbon-12 has the symbol $^{12}_6\text{C}$.

What is the relative charge on a carbon-12 nucleus?

Tick (✓) **one** box.

-6

☐

+6

☐

+12

☐

[1]

This was a well answered question. The common incorrect answer was '-6'. Very rarely was the answer '+12' given.

Question 13 (b)

(b) Another isotope of carbon is carbon-14. Carbon-14 has the symbol $^{14}_6\text{C}$

Complete the sentences to compare a nucleus of carbon-12 and a nucleus of carbon-14.

Put a **ring** around the correct statement in each box.

A nucleus of carbon-12 has

fewer neutrons than
the same number of neutrons as
more neutrons than

a nucleus of carbon-14.

A nucleus of carbon-12 has

fewer protons than
the same number of protons as
more protons than

a nucleus of carbon-14.

[2]

Many candidates gained the first marking point for fewer neutrons, although a common mistake was to get protons and neutrons mixed up. Few candidates gaining the first marking point then answered 'fewer protons than' as well.

Question 13 (c)

(c) When carbon-14 decays into nitrogen-14, it emits beta radiation.

Complete the equation for the decay of carbon-14.



[2]

Most candidates attempted the question with many obtaining at least one marking point. Common errors were the subtraction 6 - 1 giving 5 instead of 7 and placing 14 for the nucleon number for beta.

Question 13 (d)

- (d) Carbon-14 has a half-life of 5700 years.

Explain what half-life means.

.....
..... [1]

Although many candidates attempted the question, most candidates did not pick up this mark. Many were much closer to the definition than when asked it in previous series. Incorrect responses included 'works only half the time,' 'starts functioning halfway through,' and 'disappears half the time.'

Question 13 (e)

- (e) Alpha particles, beta particles, and gamma rays can penetrate different types and thicknesses of material.

Draw **one** line from each **type of radiation** to the **type and maximum thickness of material** the radiation is able to penetrate.

Type of radiation	Type and maximum thickness of material
alpha	a few sheets of paper
beta	a few centimetres of lead
gamma	a few millimetres of aluminium

[2]

Most candidates scored at least a mark on this question which required recall of information.

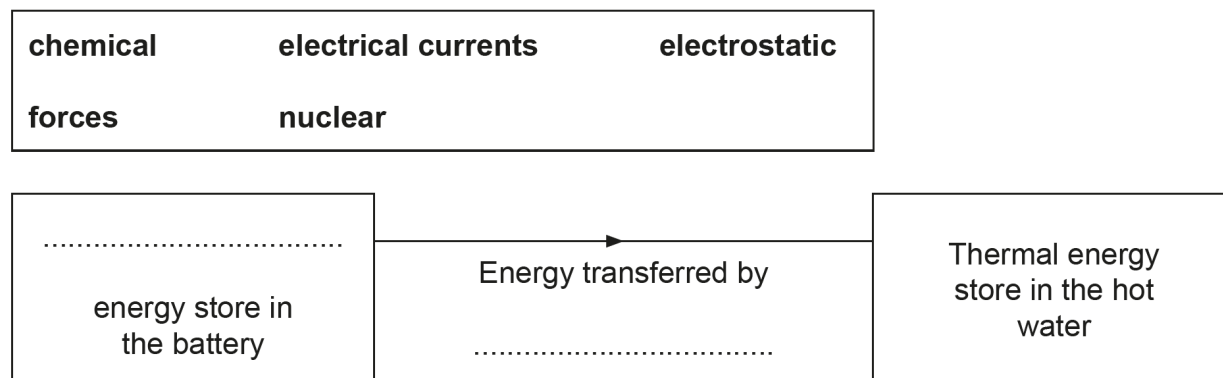
Question 14 (a) (i)

14

(a) Some types of kettle are battery powered.

(i) Complete the diagram to show how energy is transferred when a battery powered kettle heats water.

Use words from the list.



[2]

The 'electrical currents' marking point was correctly obtained by most candidates but 'chemical' less so. The common errors made here involved either 'electrostatic' or 'nuclear'.

Question 14 (a) (ii)

- (ii) The kettle contains 0.50 kg of water at 20 °C.

Calculate the minimum change in thermal energy needed to raise the temperature of the water to 100 °C.

The specific heat capacity of water is 4200 J/kg °C.

Use the equation:

change in thermal energy = mass × specific heat capacity × change in temperature

Change in thermal energy = J [3]

This question was answered well. Most candidates worked out the temperature change first before substituting into the specific heat equation. Working out was generally clear from most candidates. If 3 marks were not obtained, 2 marks were often gained for 210 000 or 42 000 (not calculating 80°C and substituting one of the given values into the equation incorrectly).

Question 14 (a) (iii)

- (iii) Explain why the **actual** amount of thermal energy needed to raise the temperature of the water would be greater than the calculated value in (a)(ii).

.....
 [1]

Candidates found this question very challenging.

Exemplar 2

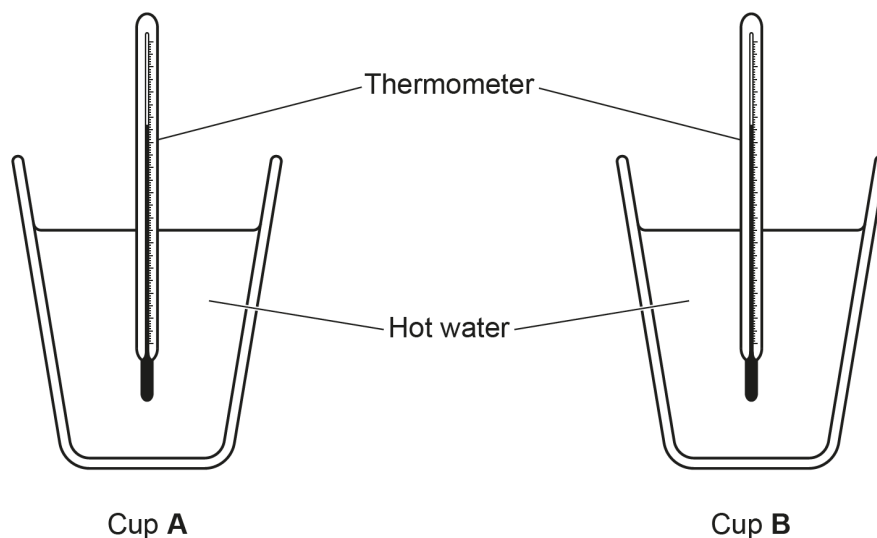
Because we calculated the minimum so the temperature would be greater. [1]

The candidate, as did many others, stated that this is minimum energy, from the stem of question, and did not explain, as given by the command word in the question.

Statements such as 'water could boil at more than 100' were common.

Question 14 (b) (i)

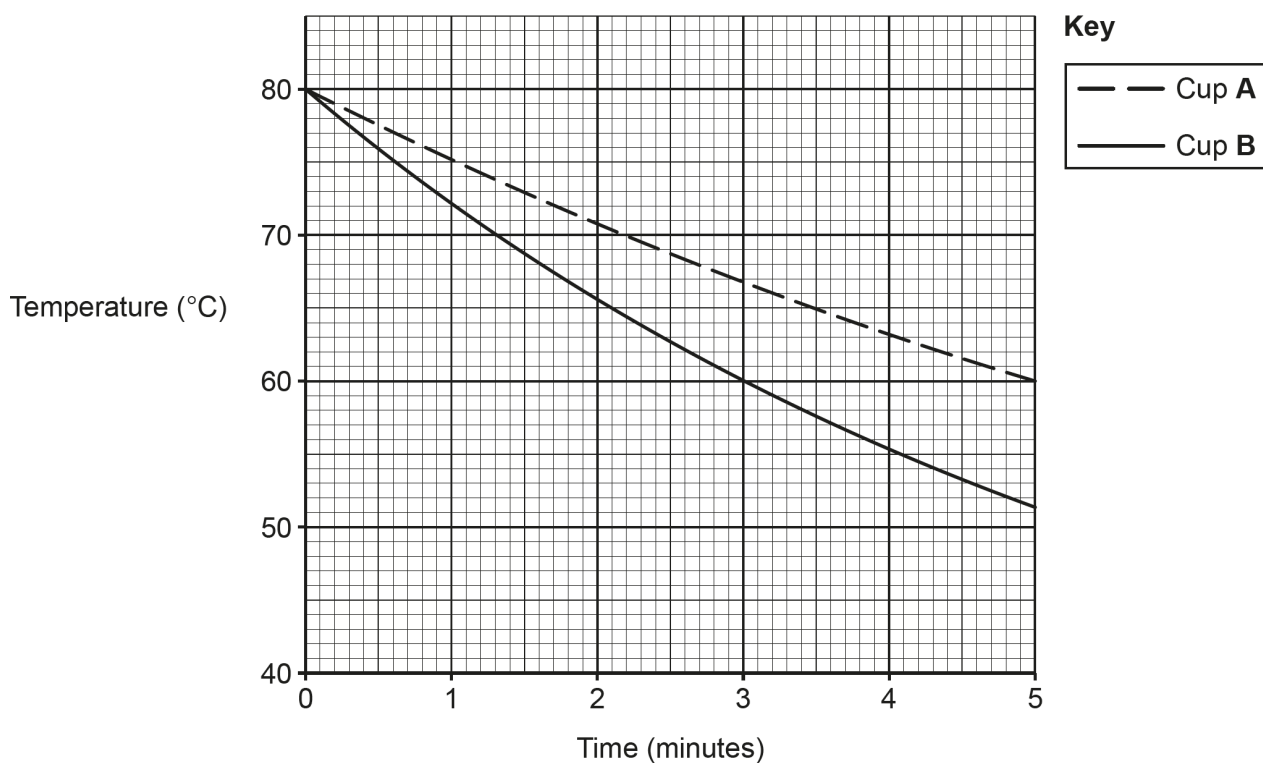
- (b)** A group of students compare the cooling of hot water in two different cups **A** and **B**, shown in the diagram.



The students:

- fill each cup with hot water,
- measure the temperature of the water for 5 minutes.

The graph shows the results for cup **A** and cup **B**.



- (i)** What is the time taken for the temperature of the water in cup **B** to decrease from 80 °C to 60 °C?

Time taken = minutes **[1]**

The majority of candidates obtained this mark.

Question 14 (b) (ii)

(ii) One cup is made of metal and the other cup is made of plastic.

The metal cup is a better conductor than the plastic cup.

Which cup, **A** or **B**, is made of metal?

Give a reason for your answer using information from the graph.

Cup

Reason

[2]

Candidates found gaining both marks challenging in this question. Most candidates stated A as the answer (therefore scoring 0 marks) but often interpreted the graph correctly. This indicated that some candidates confused the meaning of conductor with insulator.

Question 14 (b) (iii)

(iii) Suggest **two** variables the students should control in their experiment.

1

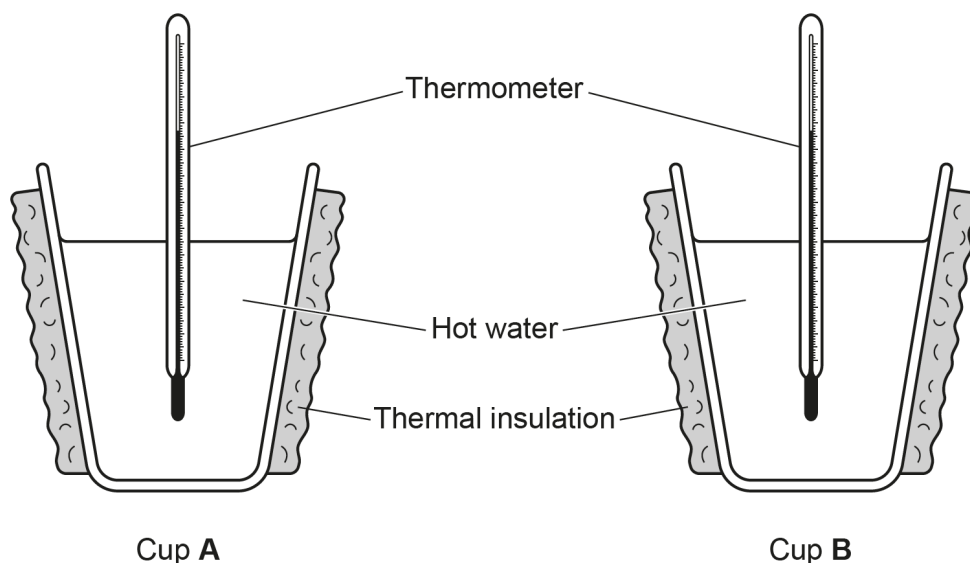
2

[2]

'Amount of water' was the most common correct answer and then 'size of cup' and 'starting temperature of water'. Most understood the idea of variables that need to be controlled. Incorrect answers included 'temperature' but not qualifying with 'starting' or 'room (temperature)'. The responses focused on keeping the time the same and using the same cup, without qualification.

Question 14 (b) (iv)

- (iv) The students wrap the cups in thermal insulation and repeat the same experiment, as shown in the diagram.



Predict how these **new** temperature readings after 5 minutes compare to the original results on the graph.

Give a reason for your answer.

Prediction

.....

Reason

.....

[2]

Most candidates obtained the first marking point for the idea of hotter for longer or smaller decrease in temperature. However, many candidates did not obtain the second marking point due to not correctly stating that **more** heat is trapped or **less** heat is lost. Some candidates did not understand the difference between temperature and heat.

Question 15*

15* A person is driving a car on a motorway. It starts to rain and the driver is feeling tired.

The driver decides to leave more space between their car and the car in front of them in case they need to stop suddenly.

Why is it a good idea for the driver to leave more space?

In your answer:

- Describe other factors that affect the thinking distance and factors that affect the braking distance of the car.
- Explain how the stopping distance of the car is affected when it is raining and the driver is tired.

.....

.....

.....

.....

.....

..... [6]

Most candidates attempted this question. Very few blank responses indicated that this question was accessible, with all possible marks seen. Many candidates that attempted the question achieved a Level 1 answer for failing to address both bullet points. Most candidates were able to articulate how tiredness leads to a slower reaction or increased thinking distance. They also articulated rain or wet roads leading to slippery roads or less grip or friction. However, a large majority of students did not address the other part of the question about factors affecting braking distance and thinking distance. Where they did, candidates listed other factors of thinking distance (alcohol, drugs or distractions) compared to braking distance.

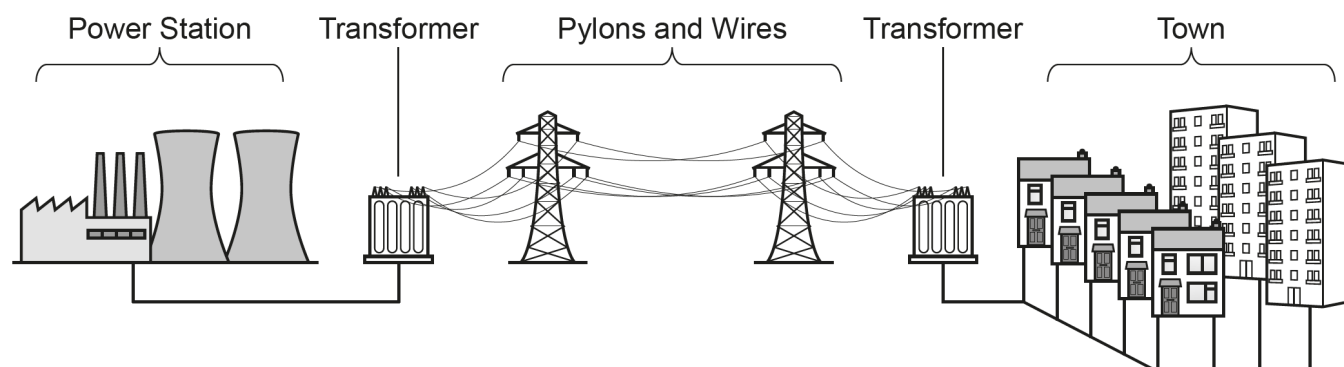
Assessment for learning



On a Level of Response question, it is important that candidates read the question carefully and address all parts of the question.

Question 16 (a)

16 The diagram shows a power station connected to a town by the national grid.



(a) The national grid uses alternating voltage.

A simple circuit powered by a battery uses direct voltage.

Explain the difference between alternating voltage and direct voltage.

.....
..... [1]

Candidates found this question challenging, responding with varied incorrect answers. A common incorrect idea was that 'direct voltage went straight to people's homes whereas alternating voltage went different routes/went through several stages'.

Question 16 (b) (i)

(b) The table shows the current in one of the wires in the national grid at two different voltages.

Voltage across wire (V)	Current in wire (A)
11 000	730
400 000	20

(i) The wire has a resistance of 2.0Ω .

Calculate how much power is dissipated from the wire at 11 000 V.

Use the equation: $\text{power} = \text{current}^2 \times \text{resistance}$

Give your answer to **2** significant figures and in **MW**.

Power dissipated = MW **[4]**

Most candidates were able to substitute values and obtain the correct answer. A common issue was not converting from W to MW. The use of 2 significant figures was also an issue for many candidates.

The significant figures mark was obtained more often than the conversion to MW mark. This reinforces the difficulty candidates had with unit prefixes in Question 9.

Question 16 (b) (ii)

- (ii) The national grid transfers 8 000 kJ of energy from the power station every second.

When the voltage across the wires is 400 000 V, the transformers and wires dissipate 160 kJ of this energy every second.

Calculate the efficiency of the energy transfer at 400 000 V.

Use the equation: $\text{efficiency} = \frac{\text{useful output energy transfer}}{\text{total energy input transfer}}$

efficiency = [3]

The most successful candidates gave higher credited answers here. Candidates had difficulty correctly selecting from the data given. The majority of candidates did not find the useful energy to obtain the first two marking points. Some candidates scored 1 mark by dividing by the total energy correctly. Many candidates often had several different sets of incompatible working out..

Exemplar 3

Use the equation: $\text{efficiency} = \frac{\text{useful output energy transfer}}{\text{total energy input transfer}}$

$$\begin{array}{r} \text{400 000} \\ \hline \end{array}$$

$$\frac{8000}{400000} = 0.02$$

$$\frac{400000}{8000} = 50$$

$$\frac{8000}{160} = 50$$

efficiency = 50 [3]

The candidate underlined the data but was unable to show how to calculate the useful energy by subtracting the total energy by the energy lost to the surroundings. The candidate then made several attempts to substitute into the equation. The attempt on the left would have scored a mark but a second incorrect equation (not crossed out) gave the same answer. This contradicted the first answer and so no mark was awarded.

Question 16 (b) (iii)

(iii) Explain how step-up transformers allow the national grid to transfer energy more efficiently.

.....

.....

.....

..... [3]

This question was particularly challenging for candidates. A common error was restating the question and writing about efficiency rather than addressing voltage, current, or energy loss. Many candidates confused efficiency with speed of energy transfer, instead of focusing on useful energy transferred.

Many candidates scored a mark by identifying that a step-up transformer increases the voltage.

Question 16 (c)

(c) A UK mains plug has 3 wires: live, neutral and earth.

Describe the function of the **neutral** wire.

.....

..... [1]

Many candidates focused on safety in this question. They mostly described the action of an earth wire. Few candidates were stated that the neutral wire completes the circuit.

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